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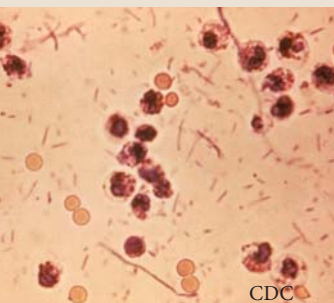
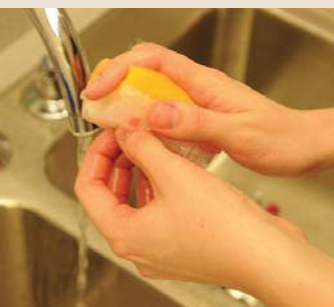
PAGE 2 Costs of war: excess health care burdens during the wars in Afghanistan and Iraq (relative to the health care experience pre-war)

PAGE 11 Substance use disorders in the U.S. Armed Forces, 2000-2011
Tammy Servies, MD; Zheng Hu, MS; Angelia Eick-Cost, PhD, ScM; Jean Lin Otto, DrPH, MPH

PAGE 17 Outbreak of gastrointestinal illness during Operation New Horizons in Pisco, Peru, July 2012
Erik J. Reaves, DO; Matthew R. Kasper, PhD; Erica Chimelski, BS; Michael L. Klein, IDMT; Ruben Valle, MD, MSc; Kimberly A. Edgel, PhD; Carmen Lucas; Daniel G. Bausch, MD

SUMMARY TABLES AND FIGURES

PAGE 20 Deployment-related conditions of special surveillance interest



Report Documentation Page				Form Approved OMB No. 0704-0188	
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Costs of War: Excess Health Care Burdens During the Wars in Afghanistan and Iraq (Relative to the Health Care Experience Pre-War)

This report estimates the health care burden related to the wars in Iraq and Afghanistan by calculating the difference between the total health care delivered to U.S. military members during wartime (October 2001 to June 2012) and that which would have been delivered if pre-war (January 1998 to August 2001) rates of ambulatory visits, hospitalizations, and hospital bed days of active component members of the U.S. Armed Forces had persisted during the war. Overall, there were estimated excesses of 17,023,491 ambulatory visits, 66,768 hospitalizations, and 634,720 hospital bed days during the war period relative to that expected based on pre-war experience. Army and Marine Corps members and service members older than 30 accounted for the majority of excess medical care during the war period. The illness/injury-specific category of mental disorders was the single largest contributor to the total estimated excesses of ambulatory visits, hospitalizations, and bed days. The total health care burdens associated with the wars in Afghanistan and Iraq are undoubtedly greater than those enumerated in this report because this analysis did not address care delivered in deployment locations or at sea, care rendered by civilian providers to reserve component members in their home communities, care of veterans by the Departments of Defense and Veterans Affairs, preventive care for the sake of force health protection, and future health care associated with wartime injuries and illnesses.

The United States military has been continuously engaged in combat operations since October 2001. The most apparent medical effects of the war – musculoskeletal and internal organ injuries, traumatic brain injuries, vision and hearing decrements, and combat stress-related mental disorders – have been described and discussed in detail.¹⁻⁷ In addition, however, there are many disabling effects of wartime service that are not directly related to combat (e.g., family stress-related conditions, gynecological and fertility disorders, skin disorders, drug and alcohol abuse, motor vehicle accidents, depression, suicide ideation, sleep disorders).

On the other hand, some medical problems affect military members less during war than peace time. For example, while military members are serving in war zones, they are at lower risk of conditions that are endemic to the United States but not to war zones, are closely associated with recreational activities (e.g., bicycle,

snow ski, swimming accidents), and so on. Also, military members may defer seeking care for some conditions while serving in war zones.

Because some illnesses and injuries that affect service members while deployed are not war-related (e.g., cancers), while others that affect non-deployed service members are war-related (e.g., injuries during deployment-specific training, sleep disorders), it is difficult to precisely characterize the types and amounts of care delivered during wartime that are directly related to war fighting.

However, the health care burden related to war fighting can be indirectly estimated by calculating the difference between the total health care delivered to military members during wartime and that which would have been delivered if participation in the war had been averted. Such assessments require comprehensive records regarding the natures and frequencies of medical encounters of military members during the

war period (“observed experience”) – and a method of estimating the natures and frequencies of medical encounters of military members that would have occurred during the war period absent participation in the war (“expected experience”). The continuous surveillance for more than 15 years of the ambulatory visits and hospitalizations of U.S. military members (using standardized electronic medical records integrated in the Defense Medical Surveillance System)⁸ enables such estimates in relation to the wars in Afghanistan and Iraq.

This report summarizes differences between the medical care experience of active component members of the U.S. Armed Forces since the beginning of the wars in Afghanistan and Iraq and the medical care experience that would have occurred if the experience immediately prior to the war had persisted during the war.

METHODS

The surveillance period was divided into pre-war and during war periods. The pre-war period was defined as 1 January 1998 through 31 August 2001; the war period was defined as 1 October 2001 through 30 June 2012. The surveillance population included all individuals who served in the active component of the U.S. Army, Navy, Air Force, or Marine Corps any time during the surveillance period.

Medical encounters for all illnesses and injuries of interest were identified by ICD-9-CM diagnostic codes between 001-999 that were reported in primary (first-listed) diagnosis positions on standardized records of ambulatory visits and hospitalizations. Encounters that were documented with records with other than illness or injury-specific diagnosis codes (ICD-9-CM 001-999) in primary (first-listed) diagnostic positions were analyzed separately (detailed results not included in this report). Such encounters included those for care not specifically related to current illnesses or injuries (e.g., medical

examinations, immunizations, screening tests) (V codes) and those documented with records that indicated the external causes (E codes) rather than the natures of injuries in primary diagnostic positions.

All records used for the analyses were routinely transmitted to the Armed Forces Health Surveillance Center (AFHSC) and integrated in the Defense Medical Surveillance System (DMSS) for health surveillance purposes.⁸ The analyses included records of health care to military members in fixed U.S. military and civilian (contracted/reimbursed care) medical facilities but not records of care delivered in deployed medical facilities or those at sea.

Health care burdens were summarized in relation to the ambulatory visits, hospitalizations, and hospital bed days that were required for the assessment, treatment, and rehabilitation of illnesses and injuries in 25 categories. The conditions included in each illness/injury category were specified by the Global Burden of Disease study (as modified for use by the AFHSC).^{9,10}

For the pre-war and war periods, the total days of military service by members of the active components of the U.S. Armed Services and the numbers of ambulatory visits, hospitalizations, and hospital bed days associated with each illness and injury-specific category of interest were enumerated. This was the “observed experience” during estimates of excess/deficit war-related medical encounters. Rates of ambulatory visits, hospitalizations, and hospital bed days during the pre-war and war periods were calculated by dividing the numbers of the respective encounters by the total person-years of active component service. Rates were expressed as encounters per 1,000 person-years of service.

The numbers of ambulatory visits, hospitalizations, and hospital bed days that would have occurred during the war period if the pre-war experience had persisted were calculated by multiplying the relevant rates during the pre-war period by the cumulative time of military service of active component members during the war period. This was the “expected experience” during estimates of excess/deficit war-related medical encounters.

“Excess/deficit” numbers of ambulatory visits, hospitalizations, and hospital bed days during the war period (relative to the experience during the pre-war period) were calculated by subtracting the “expected” from the respective “observed” numbers.

RESULTS

During the 44-month pre-war period, active component members experienced 22,116,340 ambulatory visits (crude rate: 4,454.5 per 1,000 person-years [p-yrs]), 272,381 hospitalizations (crude rate: 54.9 per 1,000 p-yrs), and 1,202,578 hospital bed days (crude rate: 242.2 bed days per 1,000 p-yrs) for evaluation, treatment, and rehabilitation of illnesses and injuries. During the pre-war period, crude rates of ambulatory visits, hospitalizations, and hospital bed days were higher among service members who were female, in the Army, black non-Hispanic, and in health care occupations compared to their respective counterparts. In relation to age, crude rates of ambulatory visits were highest among the oldest (40+ years), and rates of hospitalizations and bed days were highest among the youngest (<20) service members (**Table 1**).

During the 129-month war period, active component members experienced 84,021,447 ambulatory visits (crude rate: 5,586.4 per 1,000 p-yrs), 891,903 hospitalizations (crude rate: 59.3 per 1,000 p-yrs), and 4,277,740 hospital bed days (crude rate: 284.4 bed days per 1,000 p-yrs) related to illnesses and injuries. During the war period, crude rates of ambulatory visits, hospitalizations, and hospital bed days were higher among females, Army members, black non-Hispanics, and those in health care occupations than their respective counterparts. In relation to age, crude rates of ambulatory visits, hospitalizations, and hospital bed days were highest among the oldest (40 and older), 20-24 year olds, and youngest (<20 years) aged military members, respectively (**Table 1**).

The ratios of crude overall rates (war period versus pre-war period) of ambulatory visits, hospitalizations, and hospital bed days were 1.25, 1.08, and 1.17, respectively.

By military/demographic subgroups:

Among all military/demographic subgroups, the largest relative increases in crude rates from the pre-war to war period were among 40+ year olds for ambulatory visits (relative rate: 1.39), 30-39 years for hospitalizations (relative rate: 1.19), and those in combat-specific occupations for hospital bed days (relative rate: 1.40) (**Table 1**).

The largest absolute increases in rates from the pre-war to war period were among 40+ year olds for ambulatory visits (rate difference: +2,208 per 1,000 p-yrs) and hospitalizations (rate difference: +9.49 per 1,000 p-yrs) and those in combat-specific occupations for hospital bed days (rate difference: +88.1 per 1,000 p-yrs). Of note, among females, rates of hospitalizations and hospital bed days were lower during the war than pre-war period. Also, among service members younger than 20 years, hospitalization (but not bed day) rates were lower during the war than pre-war period (**Table 1**).

Overall, there were estimated excesses of 17,023,491 ambulatory visits (mean: +131,965 per month), 66,768 hospitalizations (mean: +518 per month), and 634,720 hospital bed days (mean: +4,920 per month) during the war period relative to that expected based on pre-war experience (**Table 1**).

Army and Marine Corps members accounted for approximately one-half (50.4%) of all excess ambulatory visits, two-thirds (64.8%) of excess hospitalizations, and three-fourths (77.9%) of excess hospital bed days during the war period. Service members in combat-specific occupations accounted for 11.3 percent, 33.6 percent, and 42.6 percent of all war period-related excesses of ambulatory visits, hospitalizations, and hospital bed days, respectively. Of note, during the war period, females accounted for nearly one-fifth (18.8%) of all excess ambulatory visits but had “deficits” of hospitalizations and hospital bed days (**Table 1**).

By illness and injury-related categories:

During the pre-war period, injuries/poisonings, musculoskeletal disorders, and respiratory infections accounted for the most ambulatory visits; the most

hospitalizations were attributable to maternal conditions, injuries/poisonings, and mental disorders; and the most hospital bed days were attributable to mental disorders, maternal conditions, and injuries/poisonings (Table 2).

During the war period, injuries/poisonings, musculoskeletal disorders, and mental disorders accounted for the most ambulatory visits; the most hospitalizations were attributable to maternal conditions, mental disorders, and injuries/poisonings; and the most hospital bed days were attributable to mental disorders, injuries/poisonings, and maternal conditions (Table 2, Figure 1).

From the pre-war to the war period, mental disorders accounted for the largest

illness/injury-specific increases in rates of ambulatory visits, hospitalizations, and hospital bed days. During the war period (relative to the expected based on pre-war experience), mental disorders accounted for more than six million excess ambulatory visits, nearly 42,000 excess hospitalizations, and more than 300,000 excess hospital bed days. Remarkably, mental disorders accounted for 35 percent, 63 percent, and 48 percent of the total estimated excesses of ambulatory visits, hospitalizations, and hospital bed days, respectively, during the war period (Table 2, Figures 1,2).

As with mental disorders, during the war compared to the pre-war period, ambulatory visit rates were much higher for musculoskeletal conditions and “signs,

symptoms, and ill-defined conditions”; hospitalization rates were markedly higher for maternal conditions, skin diseases, and injuries/poisonings; and hospital bed day rates were remarkably higher for injuries/poisonings. Together, mental disorders, musculoskeletal disorders, and signs, symptoms, and ill-defined conditions accounted for 69 percent of all excess ambulatory visits; mental disorders, maternal conditions, skin diseases, and injuries/poisonings accounted for 93 percent of all excess hospitalizations; and mental disorders and injuries/poisonings accounted for 90 percent of all excess hospital bed days (Table 2, Figures 1,2).

Of note, of the 25 illness and injury-related categories of conditions of interest,

TABLE 1. Medical encounters for current illnesses or injuries (ICD-9-CM: 001-999), by demographic/military characteristics of active component members, U.S. Armed Forces, pre-war and during war periods

	Pre-war period							War period		
	Ambulatory visits			Hospitalizations		Bed days		Ambulatory visits		
	Person-years of service	No.	Rate ^a	No.	Rate ^a	No.	Rate ^a	Person-years of service	No.	Rate ^a
Total, all illnesses/injuries	4,964,889	22,116,340	4,454.5	272,381	54.9	1,202,578	242.2	15,040,346	84,021,447	5,586.4
Gender										
Male	4,256,508	16,489,895	3,874.0	164,742	38.7	772,200	181.4	12,848,343	63,410,270	4,935.3
Female	708,381	5,626,445	7,942.7	107,639	152.0	430,378	607.6	2,192,004	20,611,177	9,402.9
Service branch										
Army	1,736,464	9,258,557	5,331.8	120,049	69.1	542,757	312.6	5,584,723	36,139,451	6,471.1
Navy	1,352,044	4,767,988	3,526.5	63,610	47.0	290,630	215.0	3,736,382	16,664,176	4,460.0
Air Force	1,246,724	5,976,529	4,793.8	60,939	48.9	244,744	196.3	3,700,542	22,220,729	6,004.7
Marine Corps	629,656	2,113,266	3,356.2	27,783	44.1	124,447	197.6	2,018,699	8,997,091	4,456.9
Age group										
<20	441,992	2,324,291	5,258.7	30,072	68.0	146,211	330.8	1,055,683	6,348,847	6,014.0
20-24	1,540,260	6,642,349	4,312.5	99,821	64.8	446,913	290.2	5,036,725	24,955,917	4,954.8
25-29	1,009,298	4,188,974	4,150.4	53,216	52.7	226,454	224.4	3,345,431	17,711,231	5,294.2
30-39	1,501,203	6,303,087	4,198.7	64,812	43.2	274,711	183.0	4,028,572	22,670,135	5,627.3
40+	472,135	2,657,639	5,629.0	24,460	51.8	108,289	229.4	1,573,936	12,335,317	7,837.2
Race-ethnicity										
White, non-Hispanic	3,126,581	13,696,111	4,380.5	163,021	52.1	720,100	230.3	9,404,064	52,373,995	5,569.3
Black, non-Hispanic	969,155	4,822,853	4,976.3	64,418	66.5	286,581	295.7	2,592,763	15,976,729	6,162.0
Hispanic	413,092	1,705,637	4,129.0	21,467	52.0	95,282	230.7	1,575,029	8,204,758	5,209.3
Other	456,061	1,891,739	4,148.0	23,475	51.5	100,615	220.6	1,468,491	7,465,965	5,084.1
Military occupation										
Combat	1,112,742	4,339,440	3,899.8	51,103	45.9	242,493	217.9	3,070,853	13,907,515	4,528.9
Health care	408,958	2,463,485	6,023.8	34,225	83.7	142,315	348.0	1,258,507	9,254,668	7,353.7
Other	3,443,189	15,313,415	4,447.5	187,053	54.3	817,770	237.5	10,710,986	60,859,264	5,681.9

^aRate per 1,000 person-years

three accounted for lower ambulatory visit rates, six accounted for lower hospitalization rates, and nine accounted for lower bed day rates during the war than in the pre-war period. The category of infectious and parasitic diseases was the only one that accounted for lower ambulatory visit, hospitalization, and bed day rates during the war than in the pre-war period (**Table 2, Figure 3**).

EDITORIAL COMMENT

This report estimates that, since the beginning of the wars in Afghanistan and Iraq, there have been approximately 17 million more ambulatory visits, 67 thousand

more hospitalizations, and 635 thousand more hospital bed days among active component military members than would have occurred if the pre-war experience had continued.

Unfortunately, while health care demands increased immediately with the initiation of war fighting, the health care burden will not return to pre-war levels immediately after the cessation of war. During the wars in Afghanistan and Iraq, many military members sustained injuries that may not have precluded the continuation of active service but do require continuing medical care (e.g., clinical follow-ups, treatment of complications, rehabilitation). Until all such individuals leave active military service, the cumulative

costs of war-related health care will increase.

Mental disorders accounted for nearly two-thirds of all estimated excess hospitalizations during the war period; and mental disorders and injuries/poisonings accounted for approximately 90 percent of all estimated excess hospital bed days. The predominance of these causes of excess hospitalizations and hospital bed days is not surprising, because they directly reflect the natures, durations, and intensities of the combat in Afghanistan and Iraq as well as the psychological stresses associated with prolonged and often repeated combat deployments.¹⁻⁷

In regard to ambulatory care, the largest proportions of excess visits were related

TABLE 1. (continued)

				War period versus pre-war period								
Hospitalizations		Bed days		Ambulatory visits			Hospitalizations			Bed days		
No.	Rate ^a	No.	Rate ^a	Rate difference, during - pre	"Excess/deficit, number"	During: pre rate ratio	Rate difference, during - pre	"Excess/deficit, number"	During: pre rate ratio	Rate difference, during - pre	"Excess/deficit, number"	During: pre rate ratio
891,903	59.3	4,277,740	284.4	1,131.9	17,023,491	1.25	4.44	66,768	1.08	42.2	634,720	1.17
562,247	43.8	2,981,836	232.1	1,061.2	13,635,236	1.27	5.06	64,970	1.13	50.7	650,937	1.28
329,656	150.4	1,295,904	591.2	1,460.2	3,200,792	1.18	-1.56	-3,420	0.99	-16.4	-35,851	0.97
421,348	75.4	2,089,369	374.1	1,139.3	6,362,575	1.21	6.31	35,253	1.09	61.6	343,783	1.20
177,281	47.4	819,982	219.5	933.5	3,487,815	1.26	0.40	1,494	1.01	4.5	16,824	1.02
196,186	53.0	818,714	221.2	1,210.9	4,481,123	1.25	4.14	15,306	1.08	24.9	92,262	1.13
97,088	48.1	549,675	272.3	1,100.7	2,221,888	1.33	3.97	8,015	1.09	74.6	150,694	1.38
68,173	64.6	356,810	338.0	755.3	797,361	1.14	-3.46	-3,653	0.95	7.2	7,590	1.02
327,507	65.0	1,642,204	326.0	642.3	3,235,119	1.15	0.22	1,088	1.00	35.9	180,777	1.12
192,443	57.5	927,576	277.3	1,143.8	3,826,414	1.28	4.80	16,053	1.09	52.9	176,969	1.24
207,298	51.5	933,858	231.8	1,428.6	5,755,404	1.34	8.28	33,371	1.19	48.8	196,654	1.27
96,482	61.3	417,292	265.1	2,208.3	3,475,666	1.39	9.49	14,941	1.18	35.8	56,294	1.16
537,099	57.1	2,645,757	281.3	1,188.8	11,179,126	1.27	4.97	46,768	1.10	51.0	479,856	1.22
181,938	70.2	809,732	312.3	1,185.7	3,074,244	1.24	3.70	9,602	1.06	16.6	43,047	1.06
91,096	57.8	436,524	277.2	1,080.3	1,701,534	1.26	5.87	9,247	1.11	46.5	73,234	1.20
81,770	55.7	385,727	262.7	936.1	1,374,667	1.23	4.21	6,182	1.08	42.1	61,752	1.19
163,454	53.2	939,760	306.0	629.1	1,931,886	1.16	7.30	22,424	1.16	88.1	270,548	1.40
109,814	87.3	461,703	366.9	1,329.9	1,673,656	1.22	3.57	4,492	1.04	18.9	23,750	1.05
618,635	57.8	2,876,277	268.5	1,234.5	13,222,682	1.28	3.43	36,755	1.06	31.0	332,379	1.13

to mental disorders, musculoskeletal disorders, and illnesses without specific diagnoses (“signs, symptoms, and ill-defined conditions”) at the times of the subject visits. Again, the finding is not surprising. Previous *MSMR* reports have documented relatively high rates of neck, back, and joint problems after wartime deployments;¹¹ also, many illnesses with unknown or unconfirmed underlying causes resolve spontaneously or with treatment of the presenting signs and symptoms. The specific causes of such illnesses often are not confirmed or documented in standardized

medical records such as those used for this report.

Of interest, in this analysis, “infectious and parasitic diseases” was the only illness/injury category with lower rates of ambulatory visits, hospitalizations, and hospital bed days during the war than in the pre-war period. There are several explanations for the finding. For example, the infectious and parasitic diseases category does not include respiratory infectious diseases (which is a separate category of the modified Global Burden of Diseases classification system used here). Respiratory infectious diseases

are very common among military members, and there were excesses of hospitalizations and hospital bed days (but not ambulatory visits) attributable to them during the war period. However, even if respiratory infections had been included in the more general infectious diseases category, there would have been deficits of care for such diseases during the war relative to the pre-war period. Also, most infectious illnesses among active military members (e.g., gastrointestinal infections, sexually transmitted infections) have acute onsets and short clinical courses. When such infections affect

TABLE 2. Medical encounters for illnesses and injuries (ICD-9-CM 001-999), by Global Burden of Disease (modified) categories, among active component members, U.S. Armed Forces, pre-war and during war periods

	Pre-war period						War period		
	Ambulatory visits		Hospitalizations		Bed days		Ambulatory visits		Hospital
Burden of disease main categories	No.	Rate ^a	No.	Rate ^a	No.	Rate ^a	No.	Rate ^a	No.
Total illnesses/injuries (ICD 001-999)	22,116,340	4,454.5	272,381	54.9	1,202,578	242.2	84,021,447	5,586.4	891,903
Blood disorders	47,192	9.5	1,140	0.2	5,730	1.2	212,927	14.2	3,753
Cardiovascular diseases	441,169	88.9	8,242	1.7	33,198	6.7	1,658,885	110.3	28,947
Perinatal conditions	3,587	0.7	17	0.0	142	0.0	27,553	1.8	177
Congenital anomalies	64,129	12.9	1,345	0.3	6,065	1.2	275,823	18.3	4,049
Diabetes mellitus	51,609	10.4	764	0.2	2,971	0.6	204,192	13.6	2,378
Digestive diseases	725,261	146.1	22,559	4.5	84,577	17.0	2,457,132	163.4	72,821
Endocrine disorders	64,904	13.1	753	0.2	2,540	0.5	321,251	21.4	2,583
Genito-urinary diseases	709,615	142.9	10,555	2.1	34,511	7.0	2,477,939	164.8	29,244
Headache	333,022	67.1	1,305	0.3	4,250	0.9	1,266,069	84.2	4,428
Infectious/parasitic diseases	1,170,300	235.7	7,908	1.6	33,256	6.7	3,045,543	202.5	17,546
Injury and poisoning	5,839,914	1,176.2	48,744	9.8	196,079	39.5	18,639,445	1,239.3	153,936
Malignant neoplasms	104,188	21.0	3,206	0.6	31,727	6.4	399,736	26.6	11,326
Maternal conditions	164,542	33.1	62,792	12.6	226,048	45.5	1,222,665	81.3	197,891
Mental disorders	1,709,397	344.3	39,432	7.9	326,659	65.8	11,210,705	745.4	161,385
Metabolic/immunity disorders	166,012	33.4	1,055	0.2	3,516	0.7	536,633	35.7	2,029
Musculoskeletal diseases	2,965,282	597.3	18,216	3.7	57,161	11.5	11,896,939	791.0	58,471
Neurologic conditions	108,768	21.9	1,963	0.4	14,353	2.9	1,498,522	99.6	9,661
Nutritional disorders	138,808	28.0	137	0.0	850	0.2	267,998	17.8	651
Oral conditions	65,601	13.2	4,391	0.9	11,309	2.3	285,973	19.0	10,382
Other neoplasms	179,359	36.1	3,782	0.8	15,748	3.2	721,785	48.0	11,709
Respiratory diseases	743,203	149.7	6,969	1.4	22,770	4.6	2,604,744	173.2	15,412
Respiratory infections	1,860,346	374.7	5,444	1.1	20,653	4.2	5,308,593	353.0	17,857
Sense organ diseases	1,668,797	336.1	1,325	0.3	5,090	1.0	5,489,637	365.0	2,770
Signs and symptoms	1,783,609	359.2	14,873	3.0	41,393	8.3	8,207,076	545.7	49,662
Skin diseases	1,007,726	203.0	5,464	1.1	21,982	4.4	3,783,682	251.6	22,835

^aRate per 1,000 person-years

non-deployed military members, medical encounters for evaluation and treatment are documented in medical records. However, when such illnesses affect deployed military members, they may be managed in deployed medical facilities but not documented in the health care records that were summarized for this report. Finally, the relatively low rates of infectious and parasitic diseases documented during the war period reflect, at least to some extent, the effective employment of countermeasures (e.g., food and water sanitation, arthropod vector control, immunizations, chemoprophylactic

drugs) against the many and diverse infectious disease threats that are endemic to Afghanistan and Iraq.¹²

The findings of this report should be interpreted with careful consideration of the objectives and inherent limitations of the analyses. Of note, the analyses were designed to estimate the “excess” health care delivered to active component military members in fixed (e.g., not deployed, at sea) U.S. military and civilian (contracted/reimbursed care) medical facilities since the beginning of war fighting in October 2001; as such, the total health care burdens

associated with the wars in Afghanistan and Iraq are much greater than those enumerated in this report.

Also, although reserve component members played significant roles in the wars in Afghanistan and Iraq, analyses for this report were limited to the medical encounters of active component members only. Reserve component members often receive health care from civilian providers in their home communities; as such, comprehensive records of all of their medical encounters during the pre-war and during war periods were not available for analyses.

TABLE 2. (continued)

			War period versus pre-war period								
izations	Bed days		Ambulatory visits			Hospitalizations			Bed days		
Rate ^a	No.	Rate ^a	Rate difference during - pre	Excess/deficit, number	During: pre rate ratio	Rate difference during - pre	Excess/deficit, number	During:pre rate ratio	Rate difference during - pre	Excess/deficit, number	During: pre rate ratio
59.3	4,277,740	284.4	1,131.9	17,023,491	1.25	4.44	66,767.8	1.08	42.20	634,720	1.17
0.2	17,027	1.1	4.7	69,966	1.49	0.02	299.6	1.09	-0.02	-331	0.98
1.9	114,071	7.6	21.4	322,433	1.24	0.26	3,979.2	1.16	0.90	13,503	1.13
0.0	1,433	0.1	1.1	16,687	2.54	0.01	125.5	3.44	0.07	1,003	3.33
0.3	18,653	1.2	5.4	81,554	1.42	0.00	-25.5	0.99	0.02	280	1.02
0.2	9,240	0.6	3.2	47,851	1.31	0.00	63.6	1.03	0.02	240	1.03
4.8	262,204	17.4	17.3	260,068	1.12	0.30	4,482.1	1.07	0.40	5,991	1.02
0.2	8,368	0.6	8.3	124,635	1.63	0.02	301.9	1.13	0.04	673	1.09
1.9	87,159	5.8	21.8	328,273	1.15	-0.18	-2,730.7	0.91	-1.16	-17,387	0.83
0.3	13,498	0.9	17.1	257,231	1.25	0.03	474.7	1.12	0.04	623	1.05
1.2	79,532	5.3	-33.2	-499,696	0.86	-0.43	-6,410.0	0.73	-1.41	-21,212	0.79
10.2	859,752	57.2	63.1	948,349	1.05	0.42	6,273.8	1.04	17.67	265,762	1.45
0.8	97,893	6.5	5.6	84,115	1.27	0.11	1,613.9	1.17	0.12	1,781	1.02
13.2	686,060	45.6	48.2	724,211	2.45	0.51	7,672.6	1.04	0.09	1,283	1.00
10.7	1,292,361	85.9	401.1	6,032,357	2.16	2.79	41,932.0	1.35	20.13	302,799	1.31
0.1	7,743	0.5	2.2	33,726	1.07	-0.08	-1,167.0	0.63	-0.19	-2,908	0.73
3.9	210,681	14.0	193.8	2,914,086	1.32	0.22	3,288.5	1.06	2.49	37,521	1.22
0.6	66,818	4.4	77.7	1,169,027	4.55	0.25	3,714.4	1.62	1.55	23,338	1.54
0.0	2,133	0.1	-10.1	-152,499	0.64	0.02	236.0	1.57	-0.03	-442	0.83
0.7	25,029	1.7	5.8	87,245	1.44	-0.19	-2,919.8	0.78	-0.61	-9,230	0.73
0.8	43,536	2.9	11.9	178,445	1.33	0.02	252.0	1.02	-0.28	-4,170	0.91
1.0	60,233	4.0	23.5	353,328	1.16	-0.38	-5,699.5	0.73	-0.58	-8,745	0.87
1.2	69,538	4.6	-21.7	-327,031	0.94	0.09	1,365.3	1.08	0.46	6,973	1.11
0.2	10,110	0.7	28.9	434,280	1.09	-0.08	-1,243.9	0.69	-0.35	-5,309	0.66
3.3	132,186	8.8	186.4	2,803,914	1.52	0.31	4,606.6	1.10	0.45	6,792	1.05
1.5	102,482	6.8	48.6	730,935	1.24	0.42	6,282.7	1.38	2.39	35,891	1.54

FIGURE 1. Estimated numbers of medical encounters based on pre-war experience (“expected”) and excess/deficit numbers during war, by illness/injury category, active component, U.S. Armed Forces

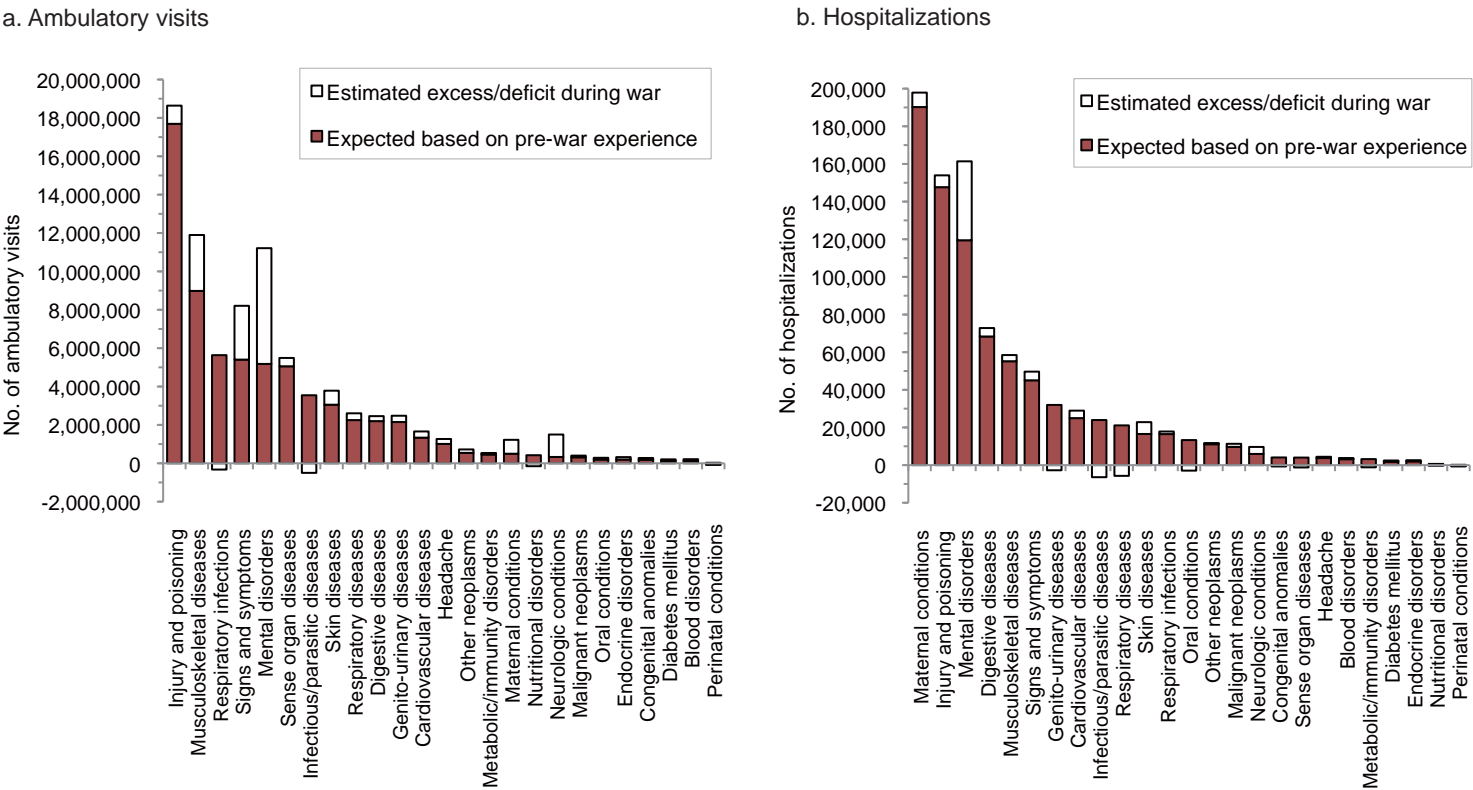


FIGURE 2. Estimated number of excess/deficit medical encounters, during war relative to pre-war period, by illness/injury category, active component, U.S. Armed Forces

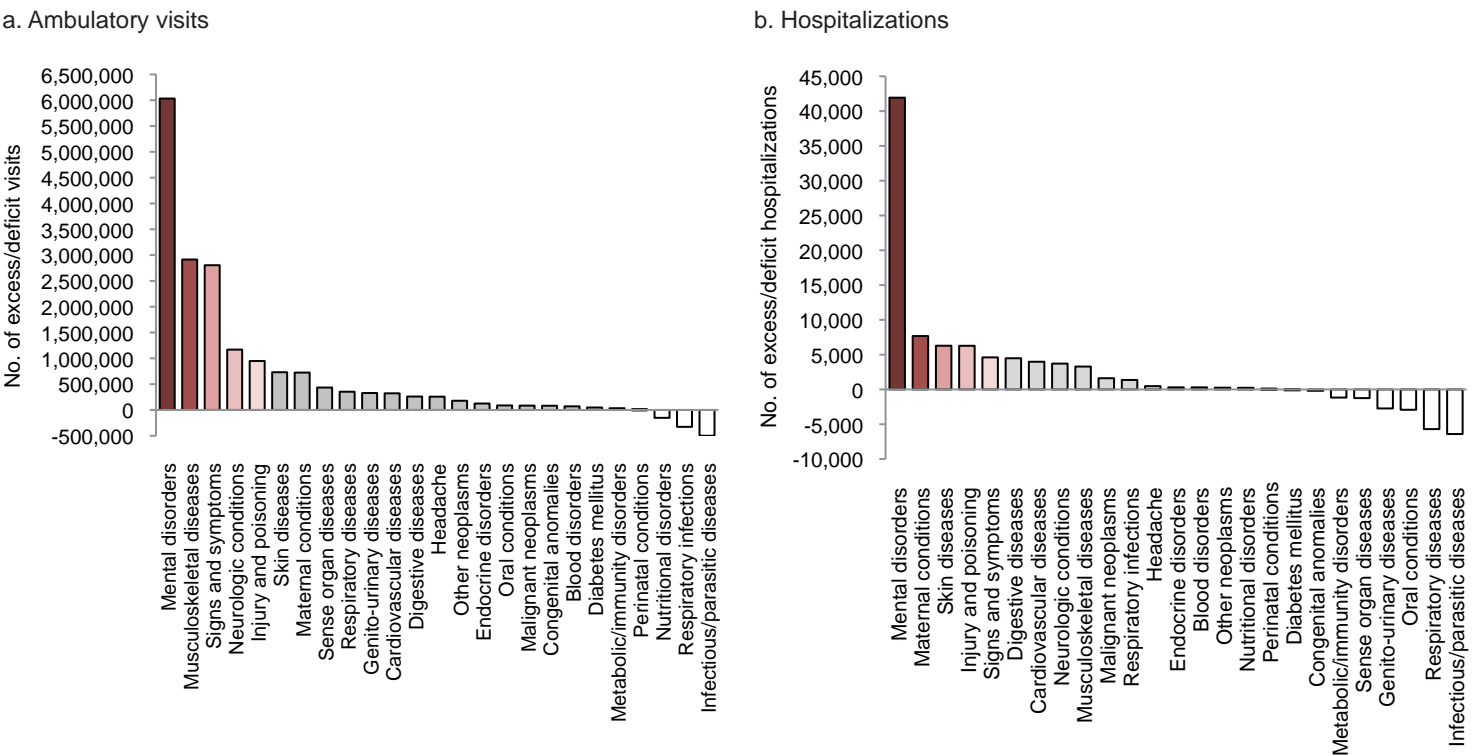


FIGURE 1. (continued)

c. Hospital bed days

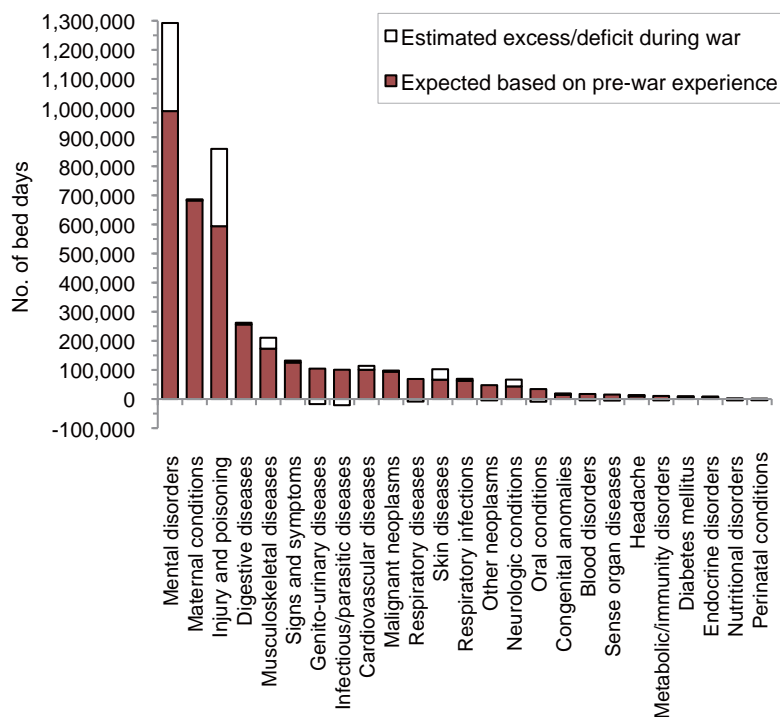
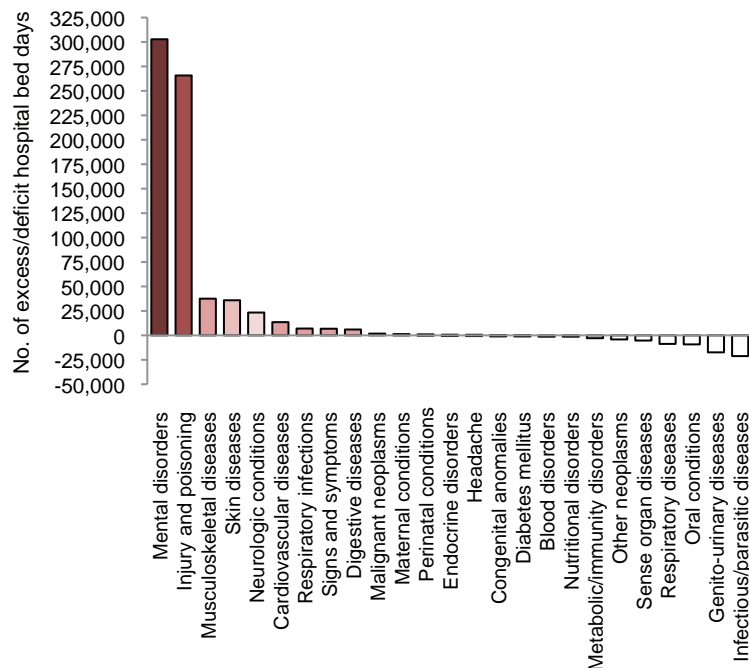


FIGURE 2. (continued)

c. Hospital bed days



In addition, many injuries sustained during the wars are chronically disabling but no longer life threatening. As such, the injuries and their complications will require decades of medical care. The health care received by military service veterans (e.g., through Military Health System and Veterans Health Administration hospitals and clinics) was not considered in this report.

Moreover, the health care that was delivered in deployed clinics and hospitals was not included in this analysis. The war-time-related health care that was not related to evaluation or treatment of a current illness or injury also was not included; such care includes pre- and post-deployment health assessments, deployment-related immunizations, pre-deployment HIV antibody screening, post-deployment mental health and hearing screening, deployment-related family counseling, and so on. Such health care is reported on medical records using diagnostic codes with V prefixes. Separate analyses of medical encounters with V- or E-coded primary (first-listed) diagnoses revealed more than 30 million excess ambulatory visits, more than 13,000 excess hospitalizations, and more than 184,000 excess hospital bed days during the war relative to the pre-war period (data not shown). The estimated excesses of such encounters are extraordinarily high because many force health protection measures were initiated or accelerated during the wars in Afghanistan and Iraq.

Clearly, if all war-related health care – since the beginning of the war until the last war veteran dies – could be accounted for, the health care burden attributable to the war would be much greater than that documented in this report.

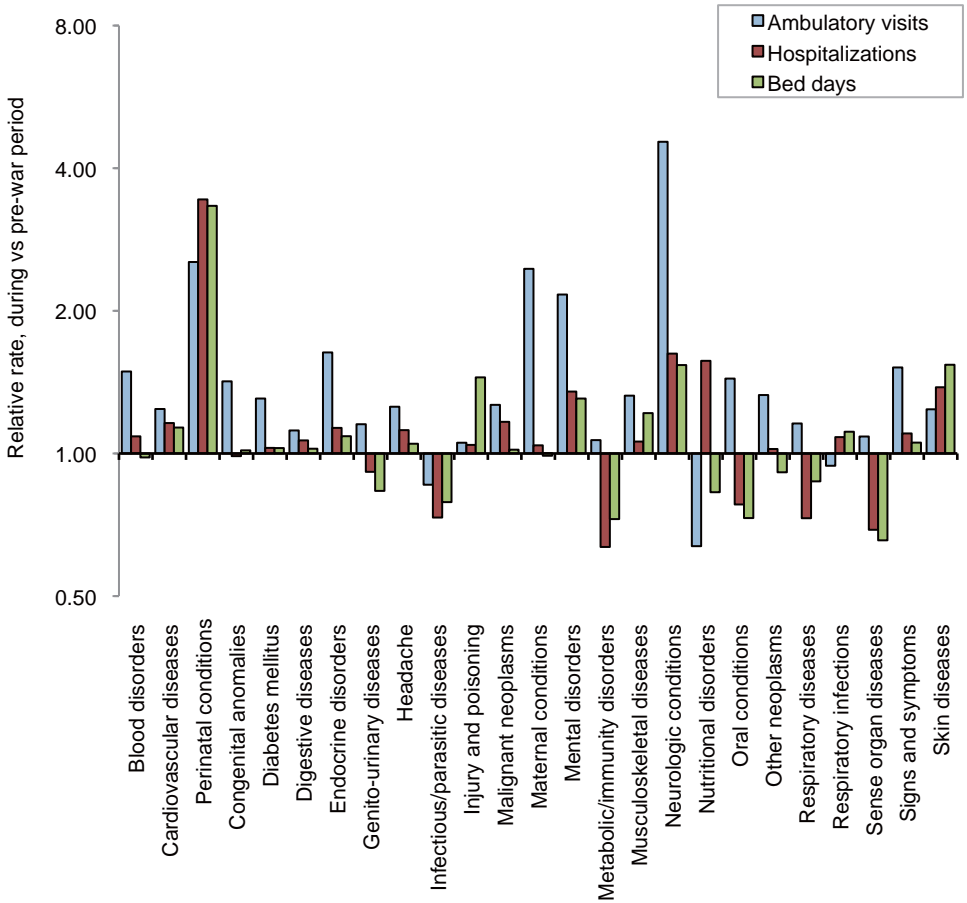
In summary, this report estimates the natures and numbers of excess medical encounters of active component members since the beginning of warfighting in Afghanistan and Iraq. The estimation methods used for the report were enabled by the Defense Medical Surveillance System, a health surveillance database that includes records of all medical encounters of active component military members in fixed military and civilian (reimbursed care) medical facilities for more than 15 years. Not surprisingly, since war fighting

began in Afghanistan and Iraq, mental disorders and injuries have accounted for the largest proportions by far of all excess hospitalizations and hospital bed days of U.S. military members. Finally, the total health care burdens associated with the wars are much greater than that reported here; unfortunately but inevitably, they will increase for decades after the cessation of war fighting.

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FIGURE 3. Rate ratios (during war versus pre-war) of ambulatory visits, hospitalizations, hospital bed days, by illness/injury categories, active component members, U.S. Armed Forces



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Substance Use Disorders in the U.S. Armed Forces, 2000-2011

Tammy Servies, MD (LCDR, U.S. Navy); Zheng Hu, MS; Angelia Eick-Cost, PhD, ScM; Jean Lin Otto, DrPH, MPH

Drug misuse is associated with serious health consequences and has detrimental effects on military readiness. During 2000 to 2011, 70,104 service members received an incident diagnosis of a substance use disorder (SUD) (excluding alcohol and tobacco-related disorders). Incidence rates declined with increasing age, time in service, rank, and number of combat deployments. Service members in a combat occupation had 1.2 times the rate of individuals in a health care or administration/supply occupation. The median time to discharge after an SUD diagnosis was longest in the Air Force (327 days) and shortest in the Navy (133 days). The substances with the highest incidence rates were cannabis (160 per 100,000 person-years [p-yrs]), "mixed/unspecified/other" (125 per 100,000 p-yrs), and cocaine (61 per 100,000 p-yrs). Incidence rates of cannabis and cocaine use diagnoses generally declined while rates of mixed/unspecified/other and opioid use increased over the surveillance period. The increasing trend in opioid-related diagnoses since 2002 may reflect an increase in prescription drug misuse. The Department of Defense recently expanded its drug testing program to screen for hydrocodone and benzodiazepines.

A preeminent concern regarding the health of members of the U.S. Armed Forces is the impact on mental health of more than a decade at war. Significant attention has been focused on conditions like post-traumatic stress disorder (PTSD), depression and anxiety, and suicidal behaviors. Concomitant with these concerns has been an increasing focus on the incidence of substance use disorders (SUDs) among military members, especially the misuse of prescription medications.

During the years 2000 to 2011, substance abuse and dependence diagnoses accounted for 4.1 percent (n=73,623) of all incident mental disorder diagnoses; while the 2011 incidence rates of SUDs were lower than those in 2009, they were higher than all of the years prior to 2009.¹ Other studies have noted increasing rates of SUDs in military populations, often in relation to deployment.^{2,3} The 2008 Department of Defense (DoD) Survey of Health Related Behaviors found that self-reported drug use has been increasing since 2005;

12 percent of military members surveyed affirmed substance use (including prescription medications) in the past 30 days.⁴ A recent DoD-sponsored Institute of Medicine (IOM) report on substance use disorders in the U.S. Armed Forces stated that outdated treatments and prevention as well as a lack of standardization of policies have led to increases in alcohol and substance use disorders – and most notably, prescription drug misuse.⁵ Any history of drug or alcohol abuse or dependence is generally considered disqualifying for entry into the military.⁶ For service members, all branches of the U.S. Armed Forces have a zero tolerance policy for illicit substance use, but the implementation of these policies differs by service.

This report summarizes counts, rates, and trends in diagnoses of substance use disorders (excluding alcohol and tobacco-related diagnoses), overall and by specific drug categories (e.g., opioid, cocaine, cannabis, etc.), among active component U.S. service members over a 12-year surveillance period. The report also summarizes

times to separation after diagnoses of substance use in each of the Services.

METHODS

The surveillance period was 1 January 2000 to 31 December 2011. The surveillance population included all individuals who served in the active component of the U.S. Armed Forces at any time during the surveillance period. All data used to determine incident substance use disorder diagnoses were derived from records routinely maintained in the Defense Medical Surveillance System (DMSS). These records document both ambulatory encounters and hospitalizations of active component members of the U.S. Armed Forces in fixed military and civilian (if reimbursed through the Military Health System) treatment facilities. Records of medical care in the Central Command theater of operations were obtained from the Theater Medical Data Store (TMDS).

For surveillance purposes, SUDs were ascertained from medical encounters that included ICD-9-CM codes for substance use diagnoses in the first or second diagnostic position (see specific codes below); diagnoses of alcohol and tobacco abuse (305.00-305.03, 305.1) were excluded. A case was defined as one inpatient medical encounter with any of the defining diagnoses in the first or second diagnostic position, two outpatient encounters (which could include TMDS encounters) within 180 days of each other with the defining diagnoses in the first or second diagnostic position, or one outpatient medical encounter in a psychiatric or mental health care specialty setting (defined by Medical Expense and Performance Reporting System (MEPRS) code: BF) with the defining diagnosis in the first or second diagnostic position. Diagnoses of misuse of specific substances were identified by ICD-9-CM codes as follows: opioid: 304.0 and 305.5; sedative, hypnotic, anxiolytic: 304.1 and

TABLE 1. Demographic and military characteristics of substance use disorders,^a active component, U.S. Armed Forces, 2000-2011

	No.	% total	Rate ^b	Incidence rate ratio	Adjusted incidence rate ratio ^c
Total	70,104	100	414	.	.
Age					
17-20	15,286	22	858	9.53	1.78
21-25	36,651	52	662	7.36	1.69
26-34	14,440	21	264	2.93	1.51
35+	3,727	5	90	Ref	Ref
Race/ethnicity					
White, non-Hispanic	46,524	66	438	1.22	1.45
Black, non-Hispanic	12,700	18	434	1.21	1.39
Hispanic	6,196	9	359	Ref	Ref
Other	4,684	7	282	0.79	1.1
Service					
Army	50,513	72	838	9.38	7.83
Navy	8,190	12	196	2.19	1.95
Air Force	3,623	5	89	Ref	Ref
Marine Corps	6,918	10	314	3.52	2.19
Coast Guard	860	1	183	2.05	2.03
Sex					
Male	62,938	90	435	1.49	1.54
Female	7,166	10	292	Ref	Ref
Grade					
E1-E4	60,806	87	820	26.08	17.64
E5-E9	8,391	12	124	3.96	3.67
Warrant	104	0	48	1.51	0.92
Officer	803	1	31	Ref	Ref
Marital Status					
Single	45,516	65	646	2.62	1.21
Married	22,704	32	247	Ref	Ref
Other	1,843	3	278	1.13	1.29
Unknown	41	0	210	0.85	0.89
Occupation					
Combat	20,505	29	585	1.42	1.18
Health care	4,694	7	342	0.83	1
Admin/supply	16,328	23	413	Ref	Ref
Other	28,577	41	353	0.86	0.93
Diagnosed in theater (OEF/OIF/OND)					
No	68,768	98	447	5.2	8.3
Yes	1,336	2	86	Ref	Ref
Prior deployments (OEF/OIF/OND)					
0	48,569	69	703	22.4	25
1	16,371	23	331	10.55	8.25
2	4,006	6	135	4.3	3.25
3	918	1	69	2.19	1.75
4+	240	0	31	Ref	Ref
Time in service					
0-5	58,689	84	1239	71.53	77.37
6-10	6,914	10	167	9.65	11.4
11-20	4,179	6	67	3.89	4.9
>20	322	0	17	Ref	Ref

^aExcludes alcohol and tobacco use disorders

^bIncidence rate per 100,000 person-years

^cAdjusted by age, gender, rank and service branch

305.4; cocaine: 304.2 and 305.6; cannabis: 304.3 and 305.2; amphetamine and other psychostimulants: 304.4 and 305.7; hallucinogen: 304.5 and 305.3; and all other to include unspecified drugs, other specified drugs, and combinations of drugs: 304.6, 304.7, 304.8, 304.9, 305.8, 305.9. ICD-9-CM coding does not explicitly specify prescription drug misuse; individuals abusing prescription medication and receiving a diagnosis of an SUD would be categorized based on the class of medication.

Individuals with SUD diagnoses prior to the beginning of the surveillance period or during the first 180 days of service were excluded as prevalent cases. Service members who were diagnosed with more than one SUD during the surveillance period were considered incident cases in each category for which they met case-defining criteria.

The summary measures utilized were incidence rate (IR) per 100,000 person-years and incidence rate ratio (IRR). Demographic characteristic-specific IRRs were adjusted for age, military pay grade, branch of service, and gender.

Time to separation was determined based on the time from an incident diagnosis of a substance use disorder of interest to the end of the affected service member's active military service (as documented by the latest military demographic record in the DMSS archive); by this method, terminations of active service by administrative separation, end of obligated service, and retirement, were ascertained. Times to separation were summarized by calculating median times to separation after diagnoses of interest and the percentages of affected individuals remaining in service at various time points following diagnoses. Individuals who were diagnosed with an SUD and subsequently died prior to separation were excluded from time-to-separation analysis.

RESULTS

During the 12-year surveillance period, 70,104 active component service members met the case definition for an incident diagnosis of SUD; the overall

incidence rate was 414 per 100,000 person-years (p-yrs) (**Table 1**). (Thirty individuals were diagnosed with an SUD within the first 180 days of service; they were considered prevalent, not incident, cases and were excluded from analyses.)

FIGURE 1. Incidence rates of substance use disorder diagnoses, by service, active component, U.S. Armed Forces, 2000-2011

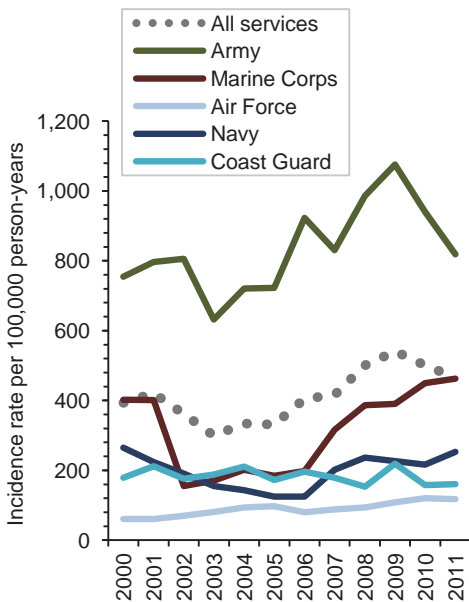
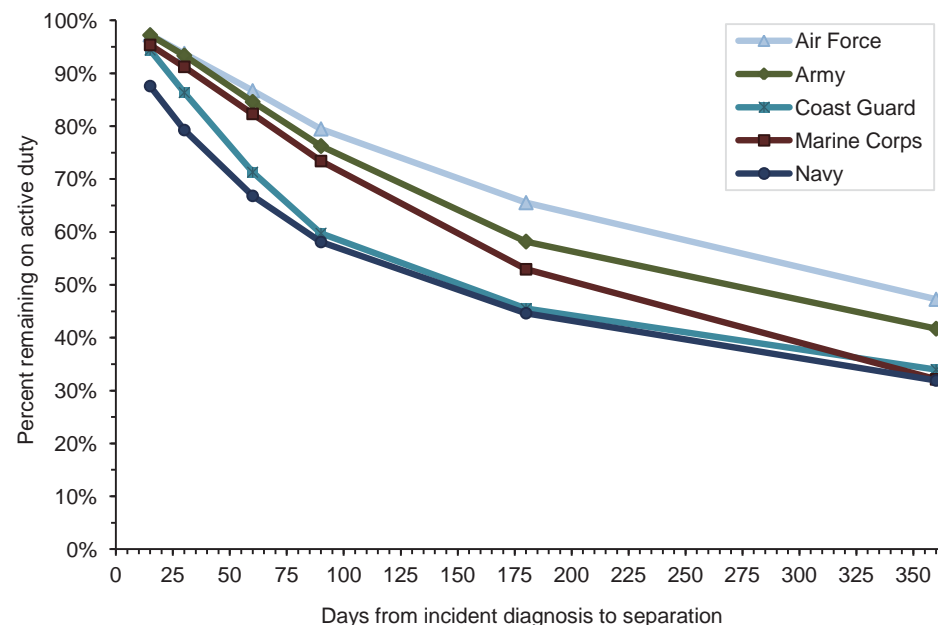
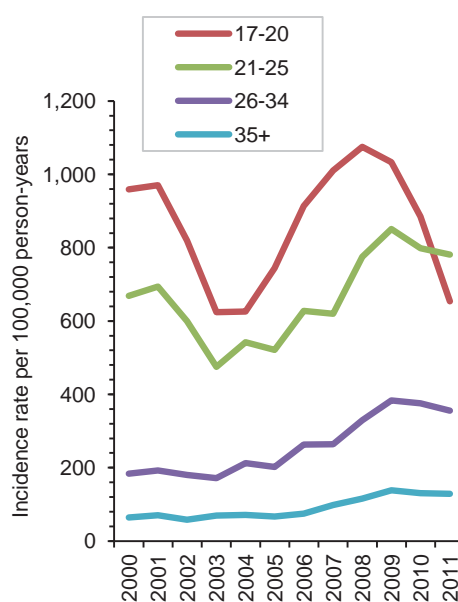


FIGURE 3. Percent remaining in active service, by time from incident substance use disorder diagnosis, active component, U.S. Armed Forces, 2000-2011



Incidence rates declined with increasing age, time in service, rank, and number of combat deployments. Those patterns generally held when adjusting for age, military rank, gender, and branch of service. The youngest service members had 1.8

FIGURE 2. Incidence rates of substance use disorder diagnoses, by age group, active component, U.S. Armed Forces, 2000-2011



times the incidence rates of the oldest service members and junior enlisted had 17.6 times the rates of officers. Individuals with no combat deployments had 25 times the incidence rate of those with four or more combat deployments. Individuals with 0-5 years of service had 77 times the incidence rate of individuals with more than 20 years of service (**Table 1**).

By race and ethnicity, white, non-Hispanics had the highest incidence rate at 438 per 100,000 p-yrs, followed closely by black, non-Hispanics, then Hispanics. Males had 1.5 times the incidence rate of females. Single individuals had 1.2 times the adjusted incidence rate of married individuals. Service members in combat occupations had 1.2 times the rate of those in healthcare or admin/supply occupations (**Table 1**).

Of all service members with at least one incident SUD diagnosis during the period, 134 died prior to discharge (and were excluded from time to discharge analyses). Among all others, the median time to discharge after an incident diagnosis of substance abuse was 232 days.

The Army consistently had the highest incidence rates of SUD, peaking in 2009, and the Air Force had the lowest. The Marine Corps experienced a steady increase in incidence since 2006 (**Figure 1**). Incidence rates peaked in the 17-20 year age group in 2008; incidence rates in the 21-25 year age group surpassed those of the 17-20 year age group in 2011 (**Figure 2**).

When evaluating time to discharge, the Air Force had the longest median time to discharge and, consistently throughout a 360 day follow-up period, a lower proportion of airmen were separated from service than members of the other services (**Figure 3**). By 360 days after an incident diagnosis, the Marine Corps had the lowest (32%) and the Air Force had the highest percentage (47%) of individuals remaining in service. The median time to discharge after an SUD diagnosis was longest in the Air Force (327 days) and shortest in the Navy (133 days) (**Figure 4**). By military grade, median times to discharge after SUD diagnoses were shortest among junior enlisted service members (E1-E4) (205 days after diagnosis) and longest among warrant officers (695 days). (**Data not shown**)

FIGURE 4. Median time to separation after incident diagnosis of substance use disorder, by service, active component, U.S. Armed Forces

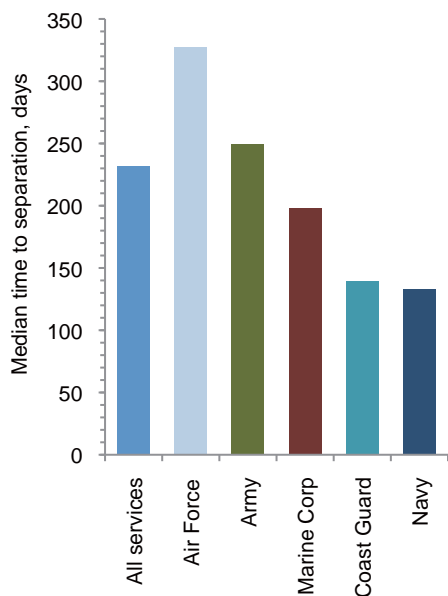


FIGURE 5. Incidence rates of substance use disorder diagnoses, by drug type, active component, U.S. Armed Forces, 2000-2011

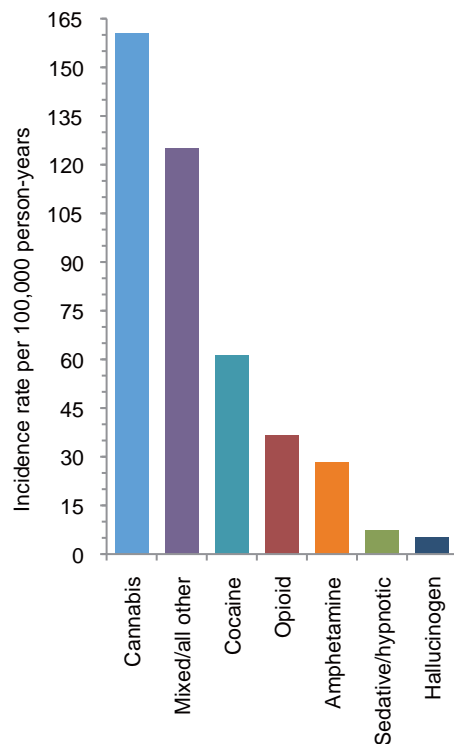


FIGURE 6. Incidence rates of substance use disorder diagnoses, by drug type, active component, U.S. Armed Forces, 2000-2011

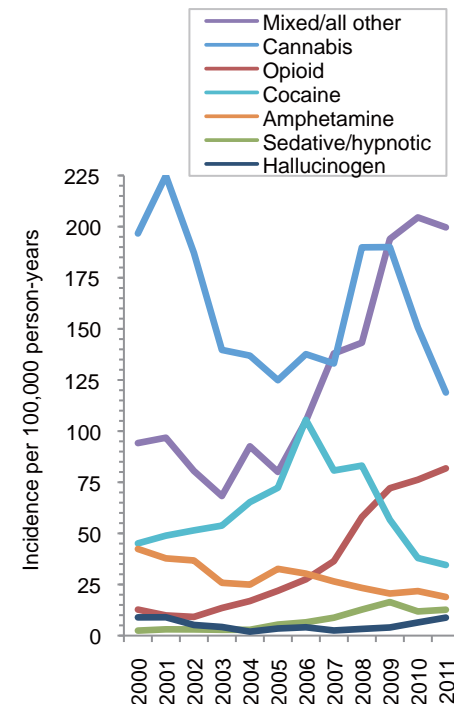
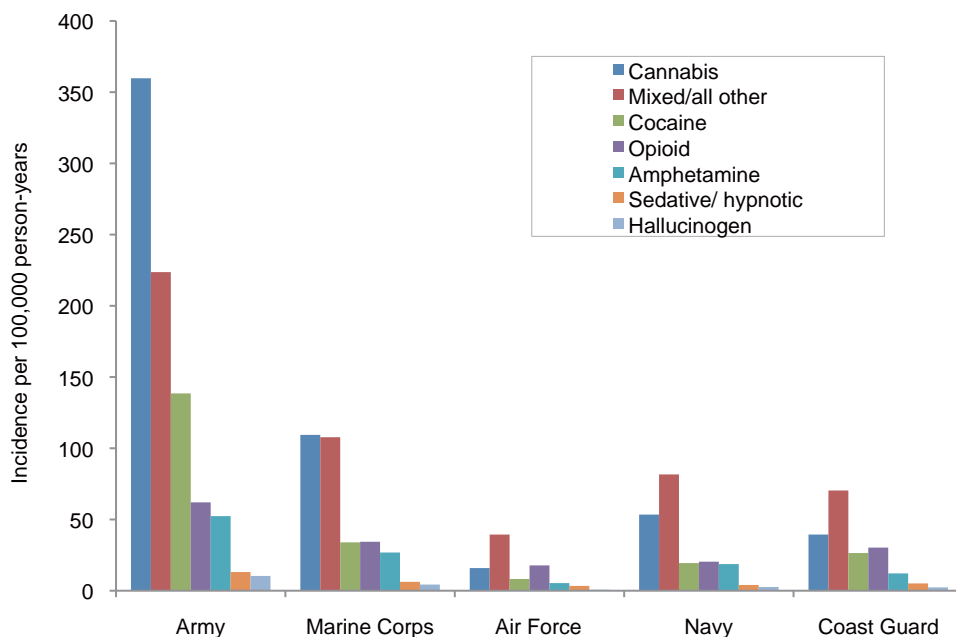


FIGURE 7. Incidence rates of substance use disorder diagnoses, by service and drug type, active component, U.S. Armed Forces, 2000-2011



During the period, the substances with the highest incidence rates of diagnosis were cannabis (160 per 100,000 p-yrs), “mixed/unspecified/other” (125 per 100,000 p-yrs), and cocaine (ICD-9-CM 304.2, 305.6) (61 per 100,000 p-yrs) (Figure 5). Incidence rates of diagnoses of cannabis and cocaine use generally declined while rates of mixed/unspecified/other and opioid use increased during the surveillance period (Figure 6). Cannabis was the substance most frequently diagnosed in the Army and Marine Corps; “mixed/unspecified/other” substances predominated in the other Services (Figure 7).

EDITORIAL COMMENT

During a 12-year surveillance period, 70,104 service members were diagnosed with a substance use disorder; cannabis was the most frequently reported specific substance on records of incident diagnoses of substance abuse. Rates of cannabis-related diagnoses declined over the surveillance

TABLE 2. Service policies for actions following identification of substance use disorders^a in service members

Service	Policy
Navy	Mandatory separation to include separation for self-referral. No timeline. Must offer treatment if dependent.
Marine Corps	Mandatory separation to include separation for self-referral. No timeline. Must offer treatment if dependent.
Coast Guard	Mandatory separation; no statement on separation for self-referral. No timeline. Must offer treatment if dependent.
Army	Mandatory separation review board to include separation review board for self-referral, separation process must begin within 30 days of notification of positive drug test. Must offer treatment if dependent.
Air Force	No mandatory separation is required. Individuals who self-refer are protected from use of that information against them. No timeline. Treatment is encouraged.

^aMandatory separation policies do not apply to alcohol and tobacco use disorders

period. In contrast, rates of diagnoses of mixed/other related disorders and opioid related disorders increased over the period.

The recent IOM report on SUDs in the military highlighted the long history of alcohol and drug misuse in the U.S. military. The report herein examines diagnoses of substance use disorders excluding alcohol misuse (which was the subject of a recent *MSMR* report);⁷ the report expands previous *MSMR* estimates of the incidence of drug abuse and dependence diagnoses by providing more granularity on diagnoses related to specific drugs.

Drug misuse is associated with serious health consequences and has detrimental effects on performance, military discipline and readiness. DoD policy has long discouraged drug abuse. Since the early 1980's, the DoD has emphasized zero tolerance of illicit drug use, and all services developed programs aimed at deterring such use. Drug testing of urine specimens has played a key role in this effort. While this no-tolerance policy extends across all services, the services differ in terms of policies related to separation of individuals who are determined to be drug users. (Table 2 summarizes service specific policies.)⁸

The increasing trend in the incidence rate of opioid-related diagnoses since 2002 may reflect an increase in prescription drug misuse; rates of prescription drug misuse have been increasing over the past several years among both military members and civilians. Although overall drug use is generally lower in the military

compared to civilian populations, prescription drug abuse has been increasing at a greater rate in the military over the past several years.^{5,8,9} The DoD has been evaluating and implementing strategies to combat this increase; notably, the DoD recently expanded its drug testing program to screen for hydrocodone and benzodiazepines (a class of drugs that includes Valium® and Xanax®).¹⁰

There are several limitations to these analyses that should be considered when interpreting the findings. The estimates of the incidence of specific substance use disorders underestimate the true incidence of these conditions for several reasons. The rates were derived by applying a surveillance case definition to administrative medical records; this process requires that individuals have a specific diagnosis of an SUD in their electronic medical record. The methodology would fail to capture individuals with SUDs who did not have a medical encounter during which an SUD was documented. It is uncommon for military members with SUDs to self-refer for medical care; thus, documented diagnoses of SUDs most often reflect command-directed referrals after SUD-related incidents or after positive urine tests for drugs. In addition, until 2012, urine drug testing failed to capture many of the commonly abused prescription drugs; as a consequence, the rates of anxiolytic and opiate-related diagnoses reported here likely underestimate the actual rates of abuse of these substances during the period of interest in this report.

The analysis of median time to discharge after SUD diagnoses by service is an indirect way of examining the potential impact of service-specific policies regarding separation from service for substance abuse. The data indicate that the median time to discharge is longest in the Air Force, which has different policies regarding separation than the other services (Table 2). However, because the data used for this report did not differentiate between separations due to SUD diagnoses and other reasons for discharge (e.g., end of service obligation, retirement), the natures and magnitudes of the impacts of service specific policies on times to discharge after detection of SUDs could not be assessed definitively.

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Outbreak of Gastrointestinal Illness During Operation *New Horizons* in Pisco, Peru, July 2012

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In July 2012, the U.S. Naval Medical Research Unit No. 6 investigated an outbreak of gastrointestinal illness characterized by diarrhea among U.S. service members participating in Operation *New Horizons* in Pisco, Peru. Overall, there were 25 cases of self-reported diarrheal illness among 101 respondents to a questionnaire (attack rate: 24.8%). Personnel who consumed food that was prepared at the two hotels where they were lodged were more likely to report diarrhea than those who did not eat at the hotels (40.9% [9/22] versus 20.3% [16/79]; RR=2.1; p=.047). The difference in diarrhea attack rates between lodgers at the two hotels was not statistically significant. Known or putative pathogens were identified in 72.7 percent (8/11) of samples tested: *Blastocystis hominis*, *Shigella sonnei*, diffusely adherent *Escherichia coli*, and norovirus genotypes I and II. The investigation's findings suggested a food-borne etiology from hotel kitchens. Among all personnel, hand-washing hygiene was reinforced; however, food sources were not restricted.

Diarrheal illness is one of the most common infectious ailments among short-term travelers and U.S. military personnel deployed to developing countries. Some studies indicate that over 50 percent of travelers may experience diarrhea during a two-week visit to a developing country.^{1,2} Epidemiologic data indicate that enterotoxigenic *Escherichia coli* (ETEC), *Campylobacter jejuni*, and *Shigella* spp. (particularly *S. flexneri* and *S. sonnei*) are the most common causes of bacterial diarrhea among adults and children living in the developing world and among U.S. military personnel deployed to these areas.²⁻⁵

Operation *New Horizons* (ONH) is an annual U.S. Southern Command-sponsored humanitarian and civic assistance exercise conducted by the U.S. military in South America. In 2012, ONH personnel participated in civil affairs engagements in the vicinity of Pisco, Peru to carry out engineering, dental, and medical projects to aid citizens living in this area affected by an earthquake in 2007.

SETTING

At the start of ONH 2012, Naval Medical Research Unit No. 6 (NAMRU-6) implemented a project to perform passive surveillance at medical aid stations for gastrointestinal and respiratory disease among U.S. military personnel. The study was designed to investigate the etiology and epidemiology of these illnesses and to strengthen diagnostic capacity and clinical decision making during ONH. On 16 July, the medical aid station reported an increase in diarrheal illness cases among U.S. engineering personnel, prompting an investigation by NAMRU-6 from 17 to 18 July 2012.

Personnel with occupations related to engineering were lodged at two hotels, hereafter identified as Hotels A and B. Hotel rooms were shared and contained hygiene facilities that included a flushing toilet, sink, and shower, which were cleaned by hotel staff daily. Latrines at worksites were contracted portable toilets.

There were small hand sanitizer gel pumps next to each group of latrines.

Food and beverages for ONH personnel both at the hotels and worksites were available from hotel restaurants, local vendors, and Meals-Ready-To-Eat (MREs). A U.S. Army veterinary specialist had inspected the hotel kitchens during the pre-deployment site survey's initial food and water risk assessment and had determined that they did not meet the minimum standards necessary to reduce the risk of food-borne illness to service members. Street vendors prepared meals in their homes or local store kitchens; their food service facilities and operators were neither licensed nor credentialed. No restrictions were placed on food sources chosen by service members during deployment.

METHODS

NAMRU-6 investigators conducted an epidemiologic survey, an environmental assessment, and patient interviews, and collected stool samples for laboratory analysis. A "suspected case of diarrheal illness" was defined as a person with one or more loose stools in a 24-hour period from 5 to 18 July. Cases were identified from reviews of outpatient medical records by the ONH medical technician and through a questionnaire administered by group interviews at Hotels A and B. The questionnaire was designed to collect data regarding demographics, health status, clinical symptoms, and food consumption habits potentially related to self-reports of diarrheal illness during the preceding two-week deployment period.

Stool samples were collected from volunteers with acute diarrhea on 17 July and were analyzed by on-site field microscopy of wet preps. Aliquots of stool samples

were preserved in sodium acetate acetic acid formalin solution, potassium dichromate solution, and Cary-Blair medium and transported to NAMRU-6 for further analysis by microscopy, culture, and polymerase chain reaction (PCR). Stool samples preserved in Cary-Blair medium were cultured for bacterial enteropathogens. Isolates of *E. coli* were tested by conventional real-time multiplex PCR for ETEC, enteropathogenic *E. coli*, and diffusely adherent *E. coli* as previously described.⁶ Real-time reverse transcription PCR for norovirus genotypes I and II was also performed using primers and probes targeting the polymerase gene.⁷

Investigators performed an environmental assessment, which included a physical inspection of hotel living quarters, hygiene facilities, kitchens, worksite latrines, and food vendors. Environmental sampling of food and water sources was not performed.

RESULTS

An epidemiological survey was distributed to 103 ONH engineering personnel who were present in Pisco at the time of the investigation. One hundred one (98.1%) surveys were completed, and 25 respondents met the case definition for a "suspected case of diarrheal illness" (attack rate: 24.8%) (Figure 1, Table 1). Thirteen (52%) suspected cases had sought care at the medical aid station and were prescribed treatment by the medical officer; five (20%) other suspected cases had self-medicated with antibiotics.

In addition to diarrhea, the 25 suspected cases reported headache (56%), abdominal cramping (52%), nausea (48%), fever (32%), and dehydration (20%). The median duration of illness was 2 days (interquartile range [IQR] 1–3 days). Twelve (48%) of the suspected cases reported stopping or significantly reducing work for at least one day (Table 1). Eleven cases (44%) provided stool samples; known or putative pathogens were identified in 8 (72.7%): *Blastocystis hominis* (n=4), *S. sonnei* (n=3), diffusely adherent *E. coli* (n=2), and norovirus genotypes I (n=2) and II (n=2). One of the *S. sonnei* isolates was not susceptible to azithromycin.

TABLE 1. Selected responses to questionnaires among study population during Operation *New Horizons* in Pisco, Peru, July 2012

	No. of cases of diarrhea	Attack rate ^a (%)
Respondents to questionnaire (n=101)	25	25
Residents of Hotel A (n=53)	10	19
Residents of Hotel B (n=48)	15	31
History of eating at Hotel A or B (n=22)	9	41
No history of eating at either hotel (n=79)	16	20
Missed work	No. of cases who missed work	% total (n=25)
Any missed work	12	48
One day of missed work	3	12
Two days	8	32
Three days	1	4
Symptom	No. with symptom	% total (n=25)
Headache	14	56
Abdominal cramping	13	52
Nausea	12	48
Fever	8	32
Dehydration	5	20
Malaise	1	4

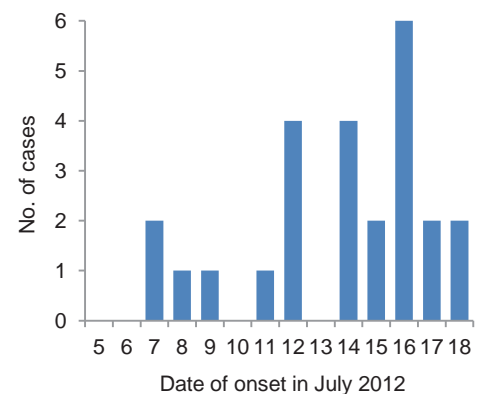
^aAttack rate is the number of cases of diarrhea divided by the number exposed

Among the engineering groups lodged at Hotels A and B, 22 personnel reported eating at least one time in their respective hotels; the other 79 individuals reported not eating at either Hotel A or B during the period. Diarrheal illness was reported by 9 of the 22 (40.9%) persons who had eaten at either Hotel A or B and by 16 of the 79 (20.3%) persons who had not eaten at the respective hotels (RR=2.1; p=0.047). There was no statistically significant difference in the proportions of diarrheal illness between those who were lodged in Hotels A or B (18.9% [10/53] versus 31.3% [15/48]; p=0.15). Seventeen of the 78 service members who responded (21.8%) reported eating food from local vendors at the ONH construction job sites. Of those, 17.6 percent (3/17) reported diarrhea.

Forty-five (44.6%) of the affected engineer group reported receiving pre-deployment preventive medicine information; 31 (30.7%) and 28 (27.7%) of the engineers recalled receipt of pre-deployment information regarding personal hygiene and diarrheal illness, respectively.

There were no statistically significant differences in suspected diarrheal illness

FIGURE 1. Cases of diarrheal illness (n=25), by date of onset during Operation *New Horizons* in Pisco, Peru, July 2012



rates in relation to demographic characteristics, hotel of residence, duration of deployment, or preventive medicine training prior to deployment.

COUNTERMEASURES

Case management and antimicrobial prophylactic measures were conducted by

the ONH medical technician in consultation with the ONH senior medical officer. Following the increase in diarrheal cases noted on 16 July, the investigative team reiterated the importance of personal hygiene measures among ONH personnel through an evening briefing at Hotels A and B. Additional hand sanitizer was provided at latrine stations on construction worksites. Immediately following stool collections on 17 July, all 48 personnel lodged at Hotel B were given an oral dose (500 mg) of ciprofloxacin (per the ONH medical officer). Restrictions on food sources were not implemented.

EDITORIAL COMMENT

This report summarizes epidemiologic and clinical characteristics of an outbreak of diarrheal illnesses that affected 25 percent of U.S. service members who were conducting engineering projects in Pisco in July 2012 and resulted in at least one missed workday for nearly half of those affected. The impact of diarrheal outbreaks on lost productivity, particularly among military reservists conducting two-week annual training during missions such as ONH, could delay project completion and mission readiness.

The investigation identified an increased risk of diarrheal illness among engineering personnel who ate at the hotels used for lodging during ONH; however, a single microbial etiology or specific type of food or meal causing the diarrheal outbreak could not be identified. The absence of a single etiologic organism suggests that infections may have been acquired from several, and perhaps even all, of the sources from which food was procured. This is not particularly surprising, since the U.S. personnel involved were likely immunologically naïve to many of the potential pathogens in the locally prepared food.

This is the second reported outbreak of diarrheal illness affecting U.S. forces deployed for U.S. Southern Command engagement missions. The first outbreak occurred during Operation *Beyond the Horizon* in El Salvador in 2011.¹ In both instances, the suspected cause of the outbreak was non-U.S. military approved food sources. In the case of ONH 2012, some

U.S. personnel frequently ate food prepared in the hotel kitchens even though the kitchens had been inspected and determined to be unsanitary during pre-deployment site assessments. Service members' knowledge about the risks of disease during deployment may have been low; among those who completed questionnaires less than half reported having received pre-deployment preventive medicine information and less than a third specified information on diarrheal illness and personal hygiene. Nevertheless, risk for food-borne illness cannot always be easily avoided; in some deployment settings it may be that there is simply no "safe" place to eat unless MREs or other safe dining options are provided and operated by the sponsoring mission. However, even in such controlled settings, outbreaks of diarrheal illness have been reported.⁸ Preventive medicine education regarding food and water use and reinforcement of principles of hand washing and good personal hygiene should be mandatory for all deployed personnel. It must be noted, however, that such measures are difficult to implement uniformly and, as a result, they have not consistently been shown to reduce the incidence of diarrheal illness.⁹

Antibiotic prophylaxis, with or without the use of an anti-motility agent, may be another option to protect deployed personnel from diarrheal illness.¹⁰ Indeed, the outbreak in Pisco prompted a decision to administer mass prophylaxis with a one-time oral dose of ciprofloxacin 500mg. However, this and other uniform antibiotic regimens may cover only a portion of the range of common etiologic organisms of traveler's diarrhea. In the case of the Pisco outbreak, only 5 of the 11 putative pathogens would have been covered by ciprofloxacin. Broader spectrum antimicrobial regimens could be considered, but likely at an increased risk of adverse events.

Diarrheal illness remains a common and challenging problem for U.S. military forces. Solutions will likely require a combination of preventive and curative options tailored to each individual setting. Thorough education of service members in general and of healthcare providers about disease prevention measures will be key to countering this disease threat to mission success. Surveillance during U.S.

military field operations such as that conducted by NAMRU-6 and GEIS in Peru for ONH 2012 can be important to unraveling the complex epidemiology of diarrheal illness in deployment settings. These settings also provide excellent opportunities for future evaluation of preventive and curative strategies.

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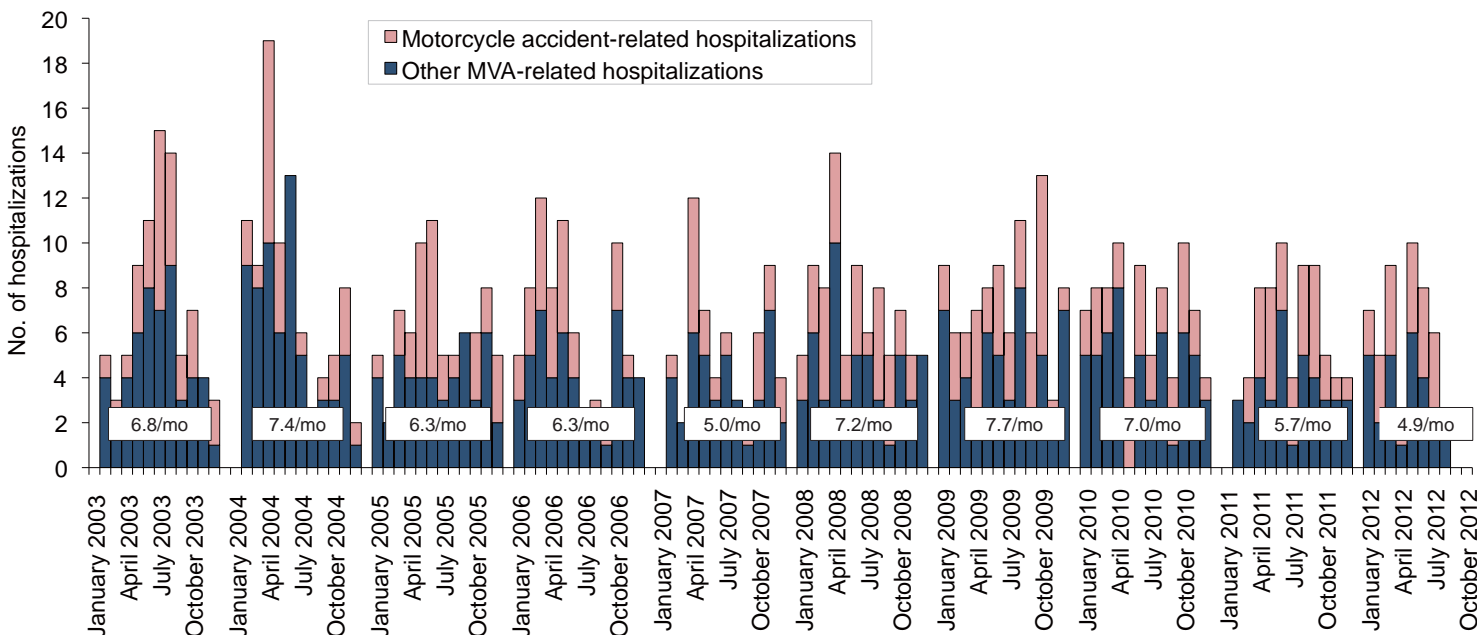
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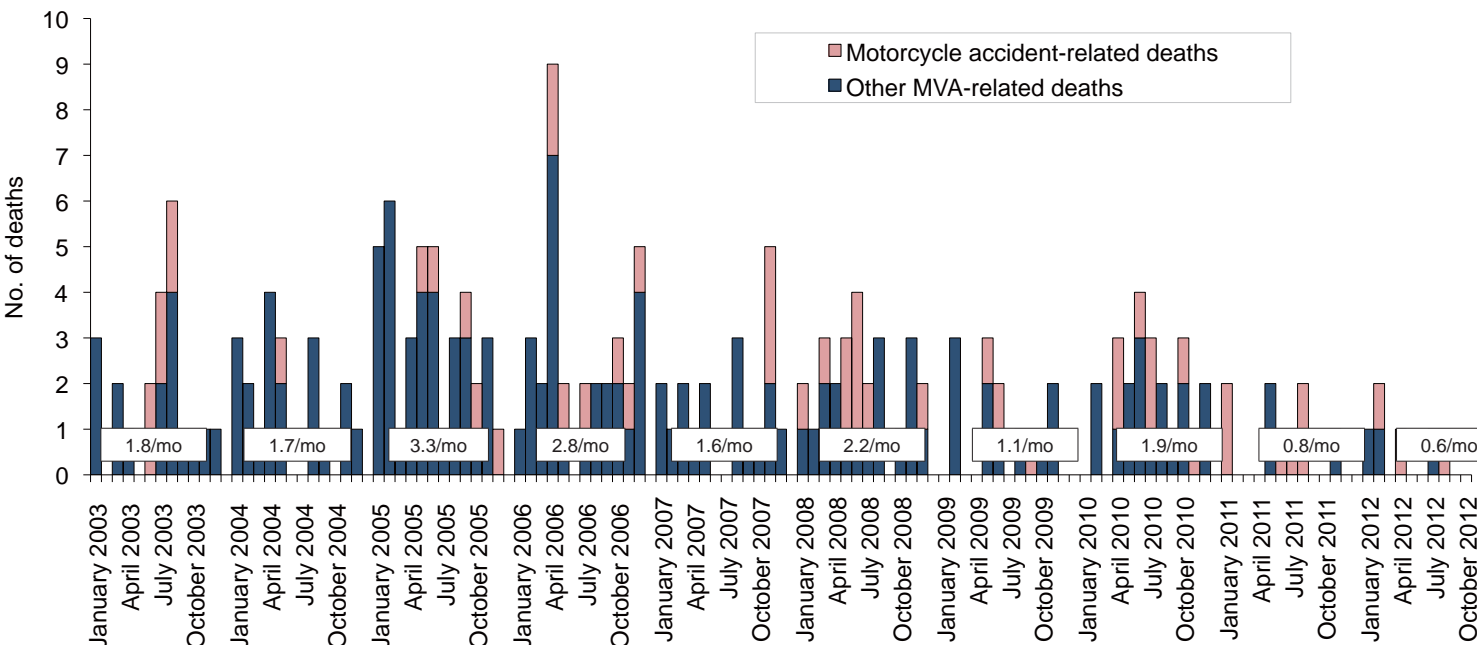
Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003-October 2012 (data as of 18 November 2012)

Hospitalizations outside of the operational theater for motor vehicle accidents occurring in non-military vehicles (ICD-9-CM: E810-E825; NATO Standard Agreement 2050 (STANAG): 100-106, 107-109, 120-126, 127-129)



Note: Hospitalization (one per individual) while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days of another motor vehicle accident-related hospitalization.

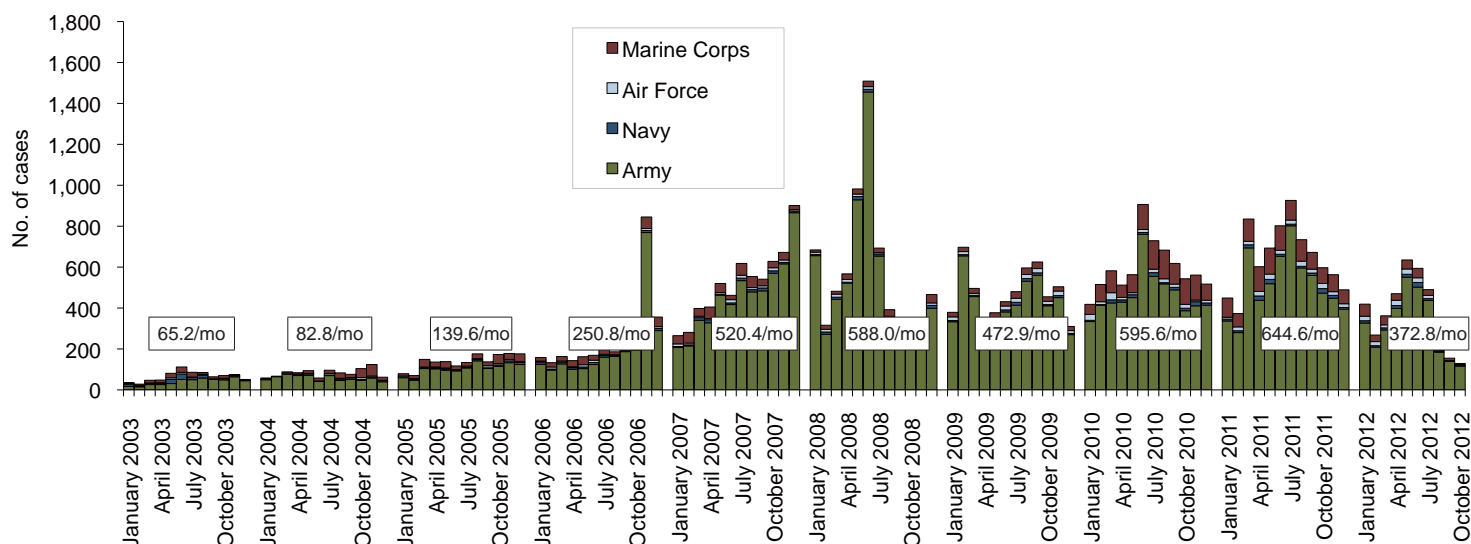
Deaths following motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (per the DoD Medical Mortality Registry)



Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. Medical Surveillance Monthly Report (MSMR). Mar 11;17(3):2-6.
Note: Death while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days prior to death.

Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003-October 2012 (data as of 18 November 2012)

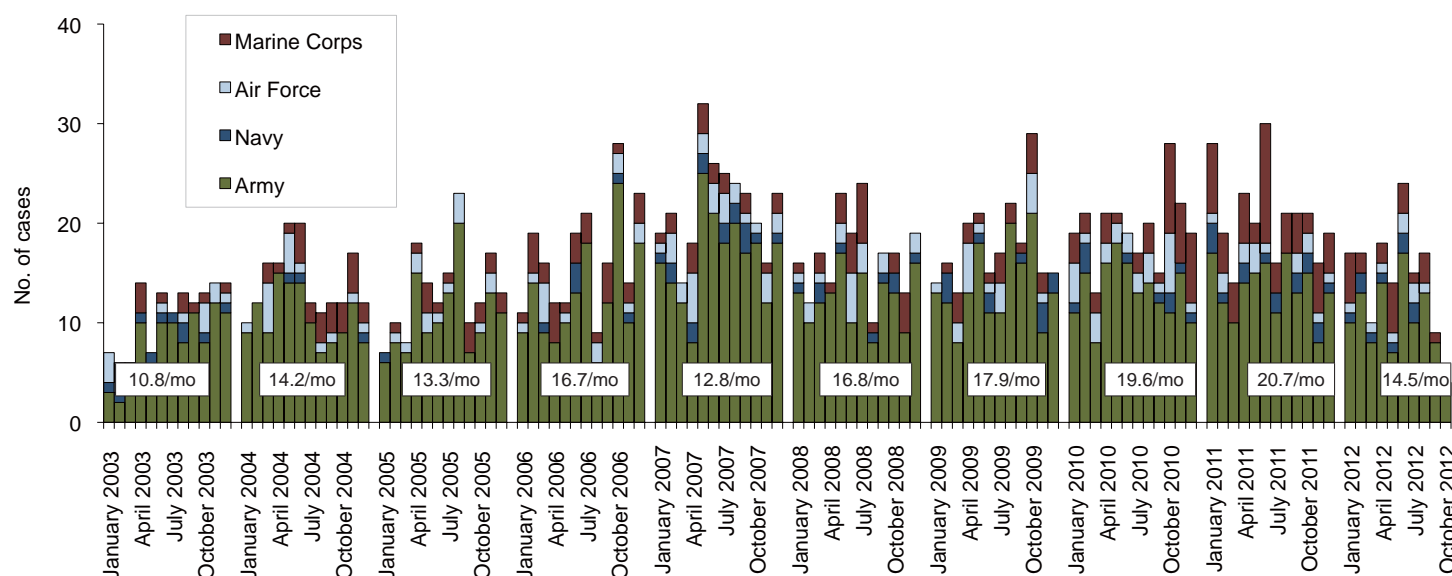
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)^a



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. Dec 2009; 16(12):2-8.

^aIndicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 3,084 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF).

Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40 - 453.42 and 453.8)^b

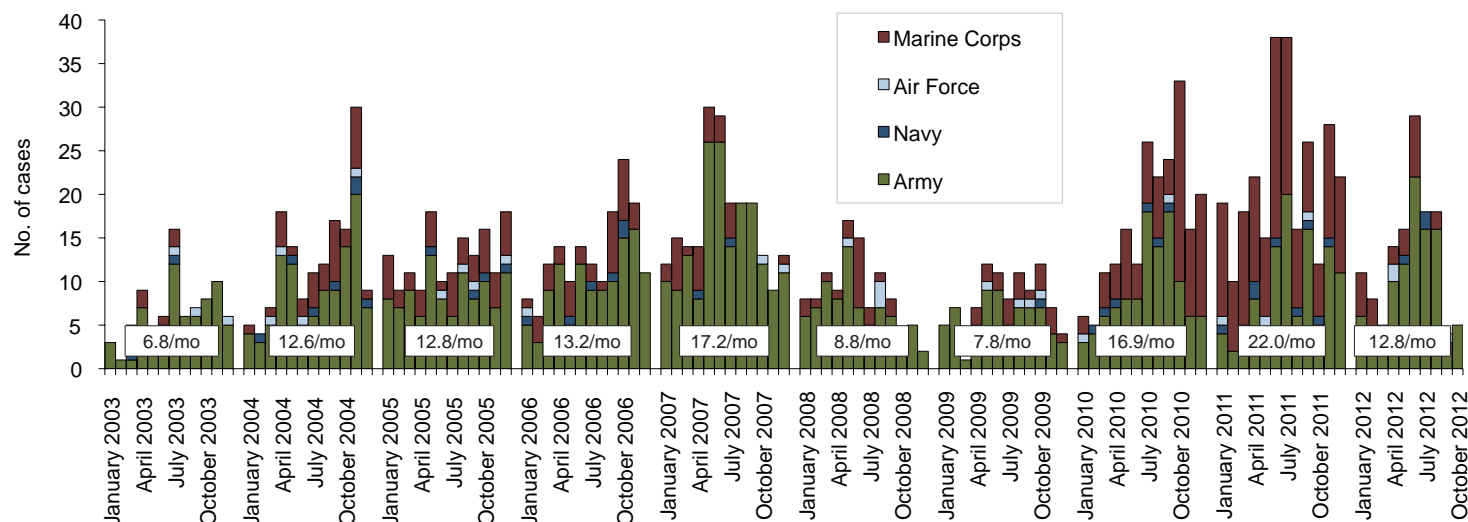


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

^bOne diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from OEF/OIF.

Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003-October 2012 (data as of 18 November 2012)

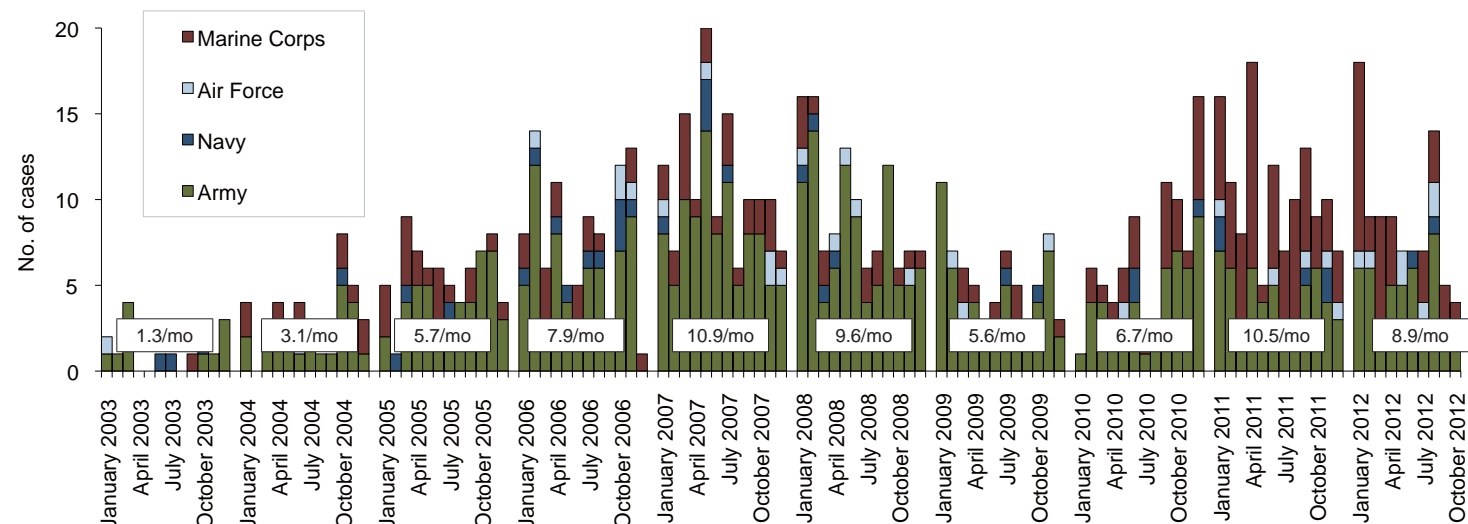
Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)^a



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990-2004. *MSMR*. Jan 2005;11(1):2-6.

^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF/OND.

Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)^b

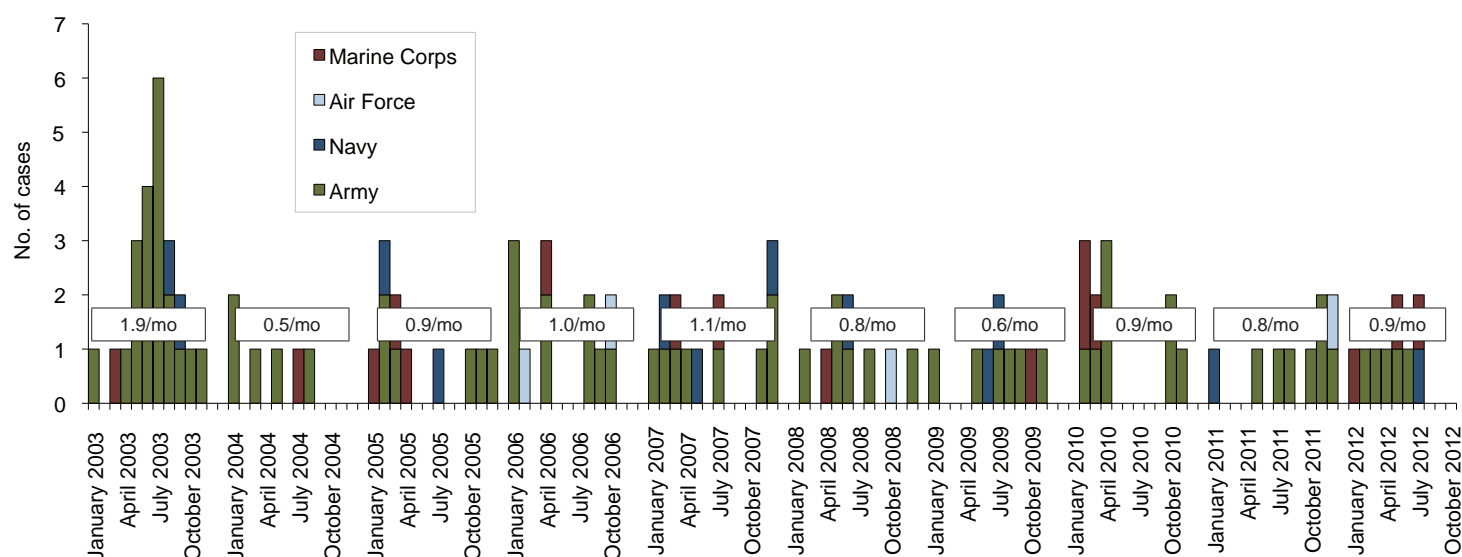


Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. *MSMR*. Aug 2007; 14(5):7-9.

^bOne diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from OEF/OIF/OND.

Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003-October 2012 (data as of 18 November 2012)

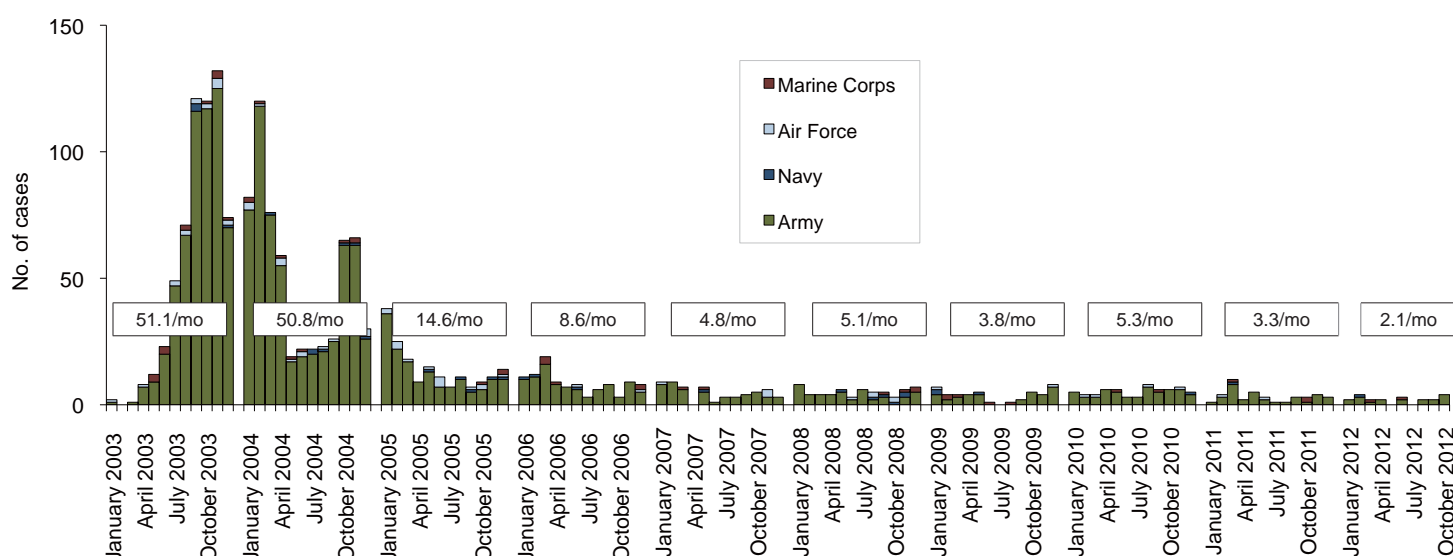
Severe acute pneumonia (ICD-9: 518.81, 518.82, 480-487, 786.09)^a



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003-November 2004. MSMR. Nov/Dec 2004;10(6):6-7.

^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

Leishmaniasis (ICD-9: 085.0 to 085.9)^b



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003-November 2004. MSMR. Nov/Dec 2004;10(6):2-4.

^bIndicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

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